

FIMS DATASET README

CAMP²Ex (2019)



Document version: 1

Data version: R1

Date: 7 June, 2020

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1. Introduction

The Fast integrated mobility spectrometer (FIMS) was developed for rapid measurements of aerosol size spectrum in the mobility diameter range of 10 nm to 600 nm (Wang et al., 2017b; Wang et al., 2017a; Wang et al., 2018). By simultaneously detecting particles of difference sizes based on the displacement of charged particles in an electric field, FIMS measures aerosol size spectrum with a time resolution of 1 Hz, about two orders of magnitude faster than conventional scanning mobility particle sizer.

1) Calibration

The FIMS was calibrated before and after the deployment on the NASA P-3 aircraft during CAMP²Ex. The calibrations included sample flow rate, sheath flow rate, separator voltage, sizing accuracy, and detection efficiency. The calibrations of sizing accuracy and detection efficiency were carried out following the procedure described in Wang et al. (2017a).

2) Sampling

The FIMS was deployed on the NASA P-3 aircraft during CAMP²Ex. The aerosol sample was dried both passively due to temperature changes upon entering the aircraft and actively by Nafion driers integrated into the FIMS inlet. The FIMS measurement was alternated between an isokinetic inlet and a CVI inlet, and the QC_Flag field in the FIMS dataset indicates the clear air measurements (i.e., through the isokinetic inlet) or measurements of evaporated cloud droplet residues (i.e., through the CVI inlet).

3) Data processing

Particle mobility was derived from the particle displacement in an electric field, which is retrieved from particle images captured by a high speed camera. Time correction was applied to account for the expected transmission time of the particles inside the FIMS. Aerosol size distribution with a time resolution of 1 Hz was derived using an inversion routine (Wang et al., 2018). The particle losses inside the sampling line and FIMS inlet were corrected.

2. Data contents and usage

“UTC” – denotes the FIMS sampling time (middle of the time bins), normally in a time interval of 1s. To account for the particle transport time inside the sampling line, we synchronized the FIMS UTC to that of DLH data by matching sharp changes in the RH measured by DLH and the total particle number concentration integrated from FIMS size distribution. The particle transport time within the sampling line was found to be ~ 11 s and quite consistent among different flights.

“n_Dp_x” (x=1-30) – denotes the particle number concentration ($dN/d\log_{10}D_p$) in each size bin measured by the FIMS.

Geometric mean particle diameters (in nm) of size bins 1-30 are 10.0000, 11.5164, 13.2627, 15.2738, 17.5899, 20.2571, 23.3289, 26.8664, 30.9403, 35.6320, 41.0351, 47.2575, 54.4235, 62.6761, 72.1802, 83.1253, 95.7302, 110.2464, 126.9639, 146.2163, 168.3880, 193.9219, 223.3276, 257.1923, 296.1921, 341.1057, 392.8299, 452.3974, 520.9976, and 600.0000, respectively. The bin width ($d\log_{10}D_p$) equals 0.061. Reported number concentrations are under STP conditions (273.15 K and 1013 hPa).

“QC_Flag” denotes the inlet state, 0 is for isokinetic inlet, 1 is for CVI inlet. Normally we filter out data measured inside clouds.

During the flights, PSL standards or filtered air were periodically introduced into the isokinetic inlet for in-flight calibration. Data during these periods are marked as “-9999”. Data that did not pass quality check are also marked with “-9999”.

If you plan to use the final version of these data in a publication, please contact the principal investigator (PI), Jian Wang (jian@wustl.edu).

References

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